What is claimed is:

1. A designing method of an acoustic matching layer of a piezoelectric transducer including a piezoelectric plate that is an electric device of a ceramic group capable of converting an electric pulse into a sound wave pulse signal, a back absorption layer that is a sound wave absorption layer for preventing an echo phenomenon of the piezoelectric plate, one or more acoustic matching layers formed in a thin layer structure constructed in order that sound waves generated in the piezoelectric plate can be transferred in the direction of a front load (in the case of nondestructive evaluation, it is referred to a tested object, and in the case of medical diagnosis, it is referred to human body), and an electric matching device that is an electric device for matching an external electric equipment and electric impedance, so that the present invention is well adapted to various fields such as medical diagnosis, underwater detection, nondestructive evaluation, etc., an optimum designing method of matching layers of a thickness-mode piezoelectric transducer that is characterized in that a front load effective impedance when in the direction of load from a front side of the piezoelectric plate as a design parameter when designing acoustic matching layers, and an impedance characteristic of each acoustic matching layer is determined using the following matching formula shown in the following table of which values are obtained based on the formula of:

$$\ln \frac{Z_{i+1}}{Z_i} = 2^{-n} C_i^{\,n} \ln \frac{Z_t}{Z_f^{(0)}}$$

where i=0,..., n, $Z_0=(Z_f)^{(0)}$, $Z_{n+1}=Z_t$, $C_i^{\,n}$=n!/(n-1)!I!, and

[Table]



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| Impedance / Number of layers | $Z_1$ | $Z_2$ | $Z_3$ |
|---|---|---|---|
| 1 | $(Z_f)^{(0)}\ (Z_t)^{1/2}$ | | |
| 2 | $(Z_f)^{(0)3/4}\ (Z_t)^{1/4}$ | $(Z_f)^{(0)1/4}\ (Z_t)^{3/4}$ | |
| 3 | $(Z_f)^{(0)7/8}\ (Z_t)^{1/8}$ | $(Z_f)^{(0)}\ (Z_t)^{1/2}$ | $(Z_f)^{(0)1/8}\ (Z_t)^{7/8}$ |

where $Z_f$ represents an effective impedance of front load viewed from the front side of the piezoelectric plate, and $(Z_f)^{(0)}$ is $(Z_f)$ at the free resonant frequency, and $(Z_t)$ is a front load impedance, and the above results are obtained until n=3.

2. The method of claim 1, wherein when designing the acoustic matching layers of the piezoelectric transducer, a video waveform, not a RF waveform, is used for evaluating sensitivity and pulse width of the piezoelectric transducer.

3. The method of claim 1, wherein an optimized design parameter is determined in a region in which an amplitude in a peak amplitude contour map and a depth in a pulse width contour map are duplicated for optimizing the design parameter.

4. A designing method of an acoustic matching layer of a piezoelectric transducer including a piezoelectric plate that is an electric device of a ceramic group capable of converting an electric pulse into a sound wave pulse signal, a back absorption layer that is a sound wave absorption layer for preventing an echo phenomenon of the piezoelectric plate, one or more acoustic matching layers formed in a thin layer structure constructed in order that sound waves generated in the piezoelectric plate can be transferred in the direction of a front load (in the case of nondestructive evaluation, it is referred to a tested object, and in the case of medical diagnosis, it is referred to human body), and an electric matching device

that is an electric device for matching an external electric equipment and electric impedance, so that the present invention is well adapted to various fields such as medical diagnosis, underwater detection, nondestructive evaluation, etc., an optimum designing method of matching layers of a thickness-mode piezoelectric transducer, comprising the steps of:

(1) a step in which a certain front load effective impedance is inputted, and a sensitivity, pulse width and performance index of a piezoelectric transducer are computed based on a KLM model computation;

(2) a step in which a minimum value of a front load effective impedance is selected based on a sensitivity, pulse width and performance index of the piezoelectric transducer computed in the step (1);

(3) a step in which a minimum value of the front load effective impedance is inserted into the matching formula shown in the following table obtained based on the following formula; and

(4) a step in which an impedance computed in the step (3) is determined as an impedance of each layer,

[formula]

$$\ln \frac{Z_{i+1}}{Z_i} = 2^{-n} C_i^n \ln \frac{Z_t}{Z_f^{(0)}}$$

where i=0,..., n, $Z_0=(Z_f)^{(0)}$, $Z_{n+1}=Z_t$, $C_i^n$=n!/(n-1)!I!, and

[Table]

| Impedance / Number of layers | $Z_1$ | $Z_2$ | $Z3$ |
|---|---|---|---|
| 1 | $(Z_f)^{(0)}$ $(Z_t)^{1/2}$ | | |
| 2 | $(Z_f)^{(0)3/4}$ $(Z_t)^{1/4}$ | $(Z_f)^{(0)1/4}$ $(Z_t)^{3/4}$ | |
| 3 | $(Z_f)^{(0)7/8}$ $(Z_t)^{1/8}$ | $(Z_f)^{(0)}$ $(Z_t)^{1/2}$ | $(Z_f)^{(0)1/8}$ $(Z_t)^{7/8}$ |

where $Z_f$ represents an effective impedance of front load viewed from the front side of the piezoelectric plate, and $(Z_f)^{(0)}$ is $(Z_f)$ at the free resonant frequency, and $(Z_t)$ is a front load impedance, and the above results are obtained until n=3.